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DEVELOPMENT OF A KINESTHETIC LEARNING SYSTEM FOR SCHOOLCHILDRENS' BASEBALL LEARNING BASED ON COMPETENCE MOTIVATION THEORY: ITS EFFECT ON STUDENTS' SKILL AND MOTIVATION

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The traditional baseball instruction strategies were mainly conducted by the instructors with oral explanation and exemplification while students had to improve their performance in athletic activities through continuous practice. During the learning process of athletic skills, students oftentimes posed less confidence due to unskilled body movement resulting in lower achievement sense. Finally, they started to reject the engagement in relevant athletic activities and even never practice anymore. Therefore, this research aimed to explore the influence on the learning motivation and the performance of athletic skills made by students in the conventionally instructive mode by introducing the Computer-Aided Design (CAD) instruction strategies of the kinect baseball learning system. Research results indicated: (1) after the kinect baseball learning system was introduced into instruction, it positively affected the learning motivation of students; (2) after the kinect baseball learning system was introduced into instruction, it positively affected the performance of athletic skills of students.

Keywords: kinect, game-based learning, competence motivation theory

1. INTRODUCTION

Digital game-based learning system (DGBL) was a kind of platform allowing students with the challenging tasks in learning, interactive learning experience with different levels, real-time feedback and the delightful sensory stimulation driven by multimedia (Aldrich 2005; Federation of American Scientists 2006; Shaffer 2006). It was found from the research conducted by Van Eck (2007) that

DGBL was also a kind of powerfully potential learning platform available to enhance the learning motivation and skills of students such as augmented reality learning system and kinesthetic game learning system.

For the past decade, researchers tried to develop various kinds of CAD learning systems and also verified that DGBL was available to enhance the learning performance, skills and motivation of students (Yun, Jiang and Li 2010; Hwang, Yang and Wang 2013). During such a period, researchers also found if the instructive material for learning was demonstrated through computer games, the learning performance of students could not live up to expectation (Wang and Chen 2010; Hwang, Wu and Chen 2012).

Namely, to enhance the learning performance of students, what the most important of all was to give students appropriate leaning support or instructive strategies and also develop suitable DGBL by focusing on instructive strategies and goals (Charsky and Mims 2008; Barak and Dori 2009). For example, in the research conducted by Zou, Liu and Yang (2012), it was found that the improvement of students' athletic skills should be well coordinated with appropriate instructive ways and strategies. Only the way with CAD systems to make instructive material converted into digital contents was never enough. Furthermore, a set of Moodle Course System dedicated to table tennis was developed. Research results also revealed that the learning system for table tennis was helpful for the performance of learning table tennis.

In view of athletic learning activities, because of unskilled body movement, learners probably showed deficient confidence, lower achievement sense and even the mind rejecting baseball (Hwang et al. 2012; Zou et al. 2012). Finally, students never practiced and involved in baseball athletic activities anymore. If through CAD learning systems or platforms availably, it would definitely enhance the learning motivation and achievement sense of students (Lin et al. 2014).

However, in view of past researches about CAD learning activities, most concentrated on the perception enhancement on subject knowledge and natural phenomenon with the applications of DGBL, but few focused on the exploration of learning motivation for athletic activities and skills. Especially, the researches on DGBL applied to baseball were deficient (Barak, Ashkar and Dori 2011; Hwang et al. 2012; Hwang et al. 2013).

Therefore, this research aimed to develop a set of kinect baseball learning system with conventionally instructive ways of athletic education introduced therein to explore the influence on the learning motivation and the performance of athletic skills made by students. To summarize the above mentioned, the goals of this research were described as below:

(1) Develop the kinect learning system for baseball. (2) Explore if the learning motivation of students was affected after the kinect learning system for baseball was introduced. (3) Explore if the performance of athletic skills made by students was affected after the kinect learning system for baseball was introduced.

2. LITERATURE REVIEW

2.1. Competence motivation theory

The competence motivation theory meant the condition to more enhance current perceived cap for better achievement reachable with an individual inspired or rewarded due to his or her excellent perceptive capabilities (Harter 1978, 1981). Whenever an individual reached something successful or admirable, he or she would be inspired or rewarded. As such, the individual would kept on proactive effort and motivation to involve in the relevant activities (Horn, Glenn and Wentzell 1993; Horn and Amorose 1998). Therefore, when an individual perceived he or she was well competent for a certain kind of capability or skill, the said individual would attempt to keep lasting interest for proficiency with long-term involvement. Differently put, when an individual perceived he or she was not competent for a certain kind of capability or skill, the said individual would not insist to complete the task and even entirely lose involvement interest and motivation (Margaryan et al. 2011).

The competence motivation theory had been widely explored and applied in the educational fields especially in the assessment on learning interest and motivation (Feltz and Brown 1984; Ommundsen and Vaglum 1991; Roberts 1992; Zou et al. 2012).

Feltz and Brown (1984) and Roberts (1992) found some facts from the athletic activities of soccer and these facts indicated that the extents of the perceptive capabilities of an individual would remarkably affect the performance, skills, learning interest and motivation in soccer. If the instruction could be conducted by using appropriate instructive strategies and methods, it would be highly helpful to enhance the perceptive capabilities of students (György 2014).

In the research conducted by Zou, Liu and Yang (2012), it was also found that the perceptive capabilities of an individual were correlated to the learning motivation and interest of table tennis. Therefore, a set of the Moodle Course Table Tennis Learning System was created and used to enhance the perceptive capabilities of an individual. To summarize the above mentioned, the competence motivation theory would be helpful to understand the learning motivation and performance of students in this research.

2.2. Digital game-based learning system

The digital game-based learning system is a kind of instructive platform allowing students with challenging tasks of learning, interactive learning experience of different levels, real-time feedback and delightful sensory stimulation of multimedia (Aldrich 2005; Federation of American Scientists 2006; Shaffer 2006).

It was from the research conducted by Van Eck (2007) that DGBL was a kind of instructive CAD platform with powerful potential to enhance the learning motivation and performance of students such as the augmented-reality learning system and the kinesthetic learning system (Hwang et al. 2013; Hwang et al. 2012; Wang and Chen 2010).

As Leite, Svinicki and Shi (2009) supposed, the types of students could be mainly divided to visual learning, hearing learning, reading or authoring preference learning and kinesthetic learning wherein kinesthetic games were oftentimes categorized as the type of kinesthetic learning. Kinesthetic games meant a kind of game platform using Open NI to control the kinect device in detecting the body movement of users such as the games titled Kinect Sports Season and EA SPORTS (Rae and Samuels 2011).

Leite et al. (2009) and BenZion (2010) indicated in their research that instructors could combine various kinds of instructive methods to trigger students' learning motivation and excellent performance. Especially, it was available to give students ample sensory simulation like kinesthetic, hearing and visual senses through kinesthetic games. It would benefit students with more outstanding learning achievement (Barak, Ashkar and Dori 2011). It was known from above scientific literatures that the auxiliary instruction with the applications of computers, multimedia or kinesthetic games could facilitate to enhance the learning motivation and interest of students.

3. RESEARCH METHODOLOGY

This research was mainly purposed to understand whether it would affect the skillful performance and learning motivation of students in athletic activities after experiments by means of quantitative methodology. The independent variable meant the instructive ways using the kinect baseball game learning system, while the dependent variable meant the skillful performance and learning motivation in athletic activities (Monahan et al. 2008; Korthagen 2010).

The baseball skill scale was mainly based on the game performance assessment instrument (GPAI) to serve as the criteria for skill assessment. GPAI was a kind of practically handy and flexible measuring tool (Thorpe, Bunker and Almond

1986). The assessment of baseball games mainly focused on the performance of skill execution in baseball games. The execution of baseball skills meant the capabilities for students to hit the gravity of a flying ball and correct hit posture as the chief assessment criteria (Griffin, Mitchell and Oslin, 1997).

Therefore, these two scales were served as the assessment criteria for baseball skills. Additionally, the learning motivation mentioned in this research was based on the sport motivation scale (SMS) developed by Pelletier et al. (1995) as the basis for assessment.

3.1. Experiment design

This research was designed with two different phases: (1) pilot study: to establish the reliability and validity of researching tools, (2) formal experiment: to validate the experimental purposes proposed by this research. Within the formal experimental tests, this research separated samples into the experimental group and the control group. Samples were adopted from the 6-graders of the elementary schools in southern Taiwan with 87 respondents totally. The members of the experimental group numbered forty-three students. Every member played the baseball kinect learning system at least once a year, along with the instruction about relevant baseball knowledge. The members of the control group numbered forty-four students and everyone received conventional paper forms instructive material and pictures about the physical education of baseball, along with relevant knowledge. All the samples of both the experimental and control groups received the practically hitting training courses of baseball with teachers' recording by the side after instructive activities were finished.

3.2. Baseball kinetic learning system design

The baseball kinetic learning system was mainly developed on the basis of Open NI and Unity. Additionally, in view of the establishment of 3D digital contents, this research used 3dsMax to produce the 3D models for roles and settings. Thereafter, the image processing software was used for mapping inclusive of diffuse maps and specular maps.

Also, through normal maps, it was available to demonstrate model details and wrinkles. Furthermore, the light maps were used to produce lighting maps and simulate the lighting conditions to reduce the consumption of system resources without lighting lamps added and shown as *Figure 1*.

Figure 1. 3D game character model

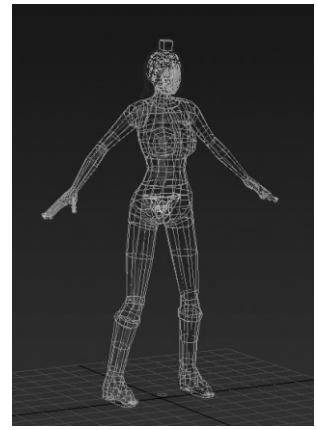

Figure 2. Game character's skeleton in 3dsMax

After role production was completed, roles were vested with biped skeletons shown in *Figure 2* and imported into Unity Priest 3D for the editing of interactive control programs with the availability the body movement of players captured by the kinect camera could be converted into skeleton data in future, thereafter, to conduct correspondent control in coordination with the skeletons on 3D models.

Figure 3. Posture correction of kinect baseball learning system

Figure 4. The kinect baseball learning system

Such a baseball kinetic learning system provided students with interesting and real-time interactive way to conduct baseball instruction. Also, during students' involvement in the instruction process, it was available to practice hitting skills through really hitting postures.

Additionally, this baseball kinetic learning system could detect students' hitting movement through the kinetic device and determine the accuracy of the hitting movement made by students shown as *Figures 3* and *4*. If students performed accurate hitting movement, time would be easier to hit the very gravity of a flying ball to ensure a longer flying distance.

After the formal experiment was completed, GPAI scales and SMS scales were given to the students of both the control and experimental groups for answering (Jarmon et al. 2009).

Finally, the collected data were conducted with the analysis of covariance (ANCOVA) to understand whether the baseball kinetic learning system could enhance students' skills and learning motivation with the researching progress shown in *Figure 5*.

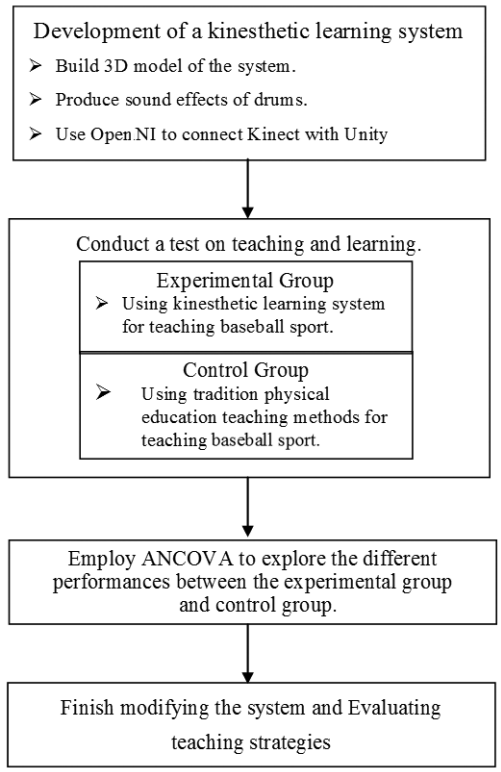

Figure 5. Research Process

4. RESEARCH RESULTS

Table 1 shows the comparison results about students' involvement motivation and skill performance in baseball between the control group and the experimental group. In view of the tested results caused by learning motivation, it could be known from *Table* 1 for the students of the experimental group during both the periods after and before the involvement of the baseball kinect learning system, the F-values for both the experimental group and the control group were 17.20 with the p-value below 0.001. Therefore, both groups were featured with significant variance. Also, the averages of learning motivation increase from the original value at 3.11 before involvement to 4.26 after involvement positively affecting the learning motivation of students. Namely, after the students of the experimental group used the baseball kinect learning system, the learning motivation in baseball was significantly enhanced. Students were more willing to involve and proficiently understand basis skills helpful to enhance learning efficiency.

Furthermore, in view of the tested results on the skillful performance of baseball, for the students of the experimental group during both the periods after and before the involvement of the baseball kinect learning system, the F-values for both the experimental group and the control group were 1719.31 with the P-value below 0.001. Therefore, both groups were featured with significant variance. The averages for the skillful performance in baseball increased from the original value at 3.18 before involvement to 4.12 after involvement positively affecting the skillful performance in baseball. Namely, after the students of the experimental group used the baseball kinect learning system, students performed more accurate hitting postures and it was easier to hit the very gravity of a flying ball.

Table 1. Students' motivation and baseball sport skills, and ANCOVA test comparing between experimental and control groups

Category	Research group	Pre-questionnaire		Post-questionnaire		F	p-value
		Mean	Std. deviation	Mean	Std. deviation		
Motivation	experimental	3.11	0.84	4.26	0.38	17.20	0.001***
	control	3.07	0.76	3.30	0.45		
Baseball sportskills	experimental	3.18	0.71	4.12	0.66	19.31	0.001***
	control	3.26	1.03	3.55	1.08		

*Significant, mean (1 to 5 point)

4.1. The correlation between students' learning motivation and skillful performance in baseball

As relevant scientific researches indicated, learning motivation and performance were both correlated. Therefore, this research conducted the Pearson correlation coefficient analysis on both the control group and the experimental group to understand the correlation between learning motivation and the skillful performance in baseball shown as *Table 2*.

There was a significant positive correlation between the learning motivation and baseball sportskills of the control group and experimental group in *table 2* (Nunnally 1978). Namely, during the process of athletic instruction, an individual with enhanced learning motivation would definitely perform better in baseball skills.

Moreover, in view of learning motivation and skillful performance in baseball, the correlation of the experimental group was twice as much as that of the control group. It also meant after the students used the baseball kinect learning system, the correlation of both variables was increased.

Table 2. Correlations between students' motivation and baseball sportskills

Research groups	*N*	Variables	Std. deviation	*r*	P-value
Experimental	43	motivation	0.38	0.31	0.001***
		baseball sportskills	0.66		
Control	44	motivation	0.45	0.13	0.05
		baseball sportskills	1.08		

Note: *** stands for $p < 0.001$

4.2. The distance of a flying ball

Table 3 (Appendix) indicated the comparison results of the distance of a flying ball for the students from both the control group and the experimental group. It was known from *Table 3* that after the students of the experimental group used the baseball kinect learning system, the distance of a flying ball increased from the 78.6 feet before involvement to 101 feet after involvement. Also, the F-value of both the control group and the experimental group was 26.41 with a p-value below 0.001.

Therefore, it existed in significant variance between the control group and the experimental group. Differently put, the baseball kinect learning system was helpful to increase the flying ball distance hit by students.

Table 3. Baseball flight distance between experimental and control groups

Category	Research group	Pre-questionnaire		Post-questionnaire		F	p-value
		Mean	Std. deviation	Mean	Std. deviation		
Baseball flight distance	experimental	78.6	11.34	101.4	8.73	26.41	0.001***
	control	73.4	10.61	78.6	9.26		

***Significant, mean (0 to 200 feet)

5. CONCLUSION

Conventionally instructive ways of baseball were mainly conveyed through spoken words and exemplification to trigger students' learning interest and motivation. Students had to continuously practice to improve their performance in athletic activities.

However, the baseball kinect learning system developed by this research was a set of instructive platform with challenging tasks for learning, interactive learning experience of different levels, real-time interaction and delightful sensory stimulation of multimedia. When the system proposed by this research was in-

troduced into the conventional courses of physical education, it had been clearly testified that it would be highly helpful to enhance students' learning motivation and skillful performance in athletic activities.

During the process of learning baseball, because of no proficiency in body movement, learners probably showed deficient confidence, lower achievement sense and the ultimate rejection of baseball. Finally, students would never practice and involve in baseball. The baseball kinect learning system is a game-based platform to make learners deeply immerged to the athletic skillful games through the interaction between learners and the kinect device.

Students' learning motivation and achievement sense would be enhanced. Moreover, the baseball kinect learning system could not only provide students with the 3D game-based learning environment, but also the kinect control device steered by Open NI to automatically detect the bat-swinging postures of a hitter with the suggestion of accurate hitting postures for learners. It would be helpful to develop students with accurate hitting postures from their earlier athletic years and further enhance baseball skills.

Finally, with the technical mature in Open NI, in the future the kinect interactive devices could be used to design a more powerful and friendly user interface.

The baseball kinect learning system developed by this research provided the instruction design in physical education with novel directions and ideas. Through the prototype structure of this system, it was available to simulate the really settings of a baseball game.

Students never worried about the risky activities of athletic safety caused by less proficient body movement. Furthermore, the problems of high technique threshold and high expenditure of relevant hardware could be addressed. It could also provide the new research directions and issues for CAD instruction.

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